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Marshall Space Flight Center
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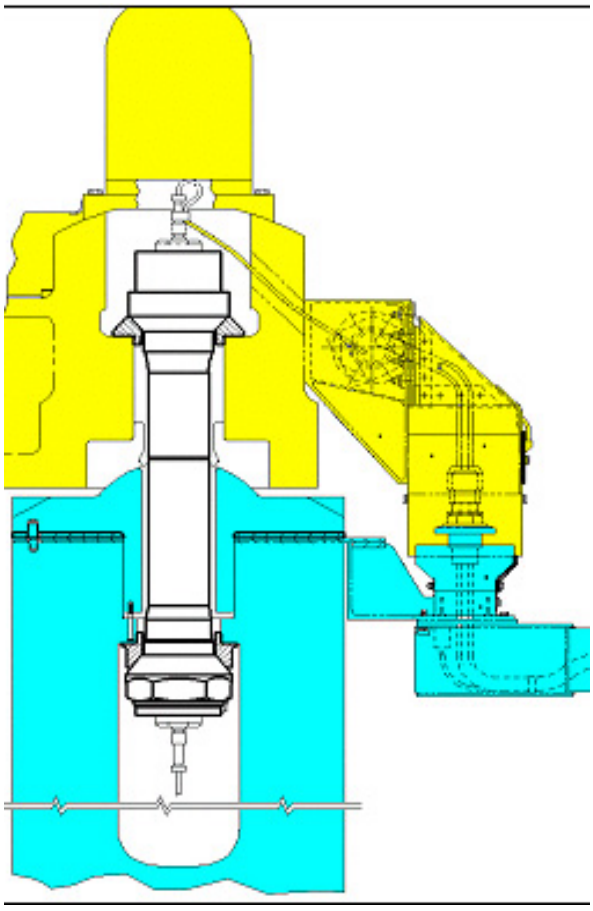
Bolt catcher modifications on the Solid Rocket

As part of NASA's effort to return to safe, reliable spaceflight, the Space Shuttle's Solid Rocket Booster Project Office is modifying the bolt catcher from a two-piece welded design to a one-piece machined design. The bolt catcher captures part of the bolt that attaches the boosters to the Shuttle's External Tank.

Each Space Shuttle flies with two bolt catchers fixed to the forward, or top, area of the External Tank at the Solid Rocket Booster/External Tank forward attach point. At approximately two minutes after launch, booster separation begins when pyrotechnic devices fire to break the bolts that hold the tank to the boosters. The forward bolt is vertically attached to both the Solid Rocket Booster and the External Tank. The canister-like bolt catcher captures the part of the bolt that is retained with the External tank; the other half of the bolt remains with the booster, secured within the forward skirt thrust post.

Though the bolt catcher is mounted on the External Tank, it is considered part of the Solid Rocket Booster element design. It is built by Summa Technologies, Inc. in Huntsville, Ala., insulated at Lockheed Martin's Michoud Assembly Facility in New Orleans, and installed on the External Tank at Kennedy Space Center in Cape Canaveral, Fla.



Bolt and Bolt Catcher

The original bolt catcher design consists of an aluminum dome welded to a machined aluminum base and bolted to the External Tank's fittings. It is about 12 inches tall, 8

inches in diameter and weighs about 11 pounds. The inside of the bolt catcher is filled with a metal, honeycomb-like energy absorber to limit the impact of the bolt as it is caught.

The bolt, known as a separation bolt, is about 25 inches long, approximately 3 inches in diameter and weighs about 70 pounds. It has a groove, or separation plane, about 11.5 inches from the top that allows it to break when the pyrotechnic devices fire.

The part of the bolt that remains on the Solid Rocket Booster is inspected after flight to ensure the break was clean. The bolt catcher and the bolt half it captures disintegrates with the External Tank as the tank falls toward the ocean.

Following the loss of the Space Shuttle Columbia and its crew, a series of tests were performed by the Solid Rocket Booster Project Office to replicate the loads, or the forces, which the bolt catcher is subjected to during launch. The testing and analysis revealed the bolt catcher had a safety margin that was less than had been previously assessed and required by the Space Shuttle Program. The bolt catcher had a factor of safety of approximately 1, lower than the 1.4 factor of safety required.

Consequently, the Solid Rocket Booster Project Office reviewed camera and video coverage available of the separation on the External Tank side. The coverage revealed that the bolt catchers functioned properly on all flights where camera footage was available.

To achieve the needed safety margin, a redesign effort was undertaken, incorporating a comprehensive testing program.

In the Return to Flight modifications, the bolt catcher housing will be made from a single piece of aluminum forging, thus removing the weld from the original design. In addition, the wall thickness will be increased and a stronger aluminum material will be used.

The Booster Project Office is also reassessing the energy-absorbing honeycomb material to ensure the one selected optimally limits the amount of load transferred into the bolt catcher. The thermal protection material is being reassessed as well; under consideration are the original super lightweight ablator, cork, and several other ablative materials currently in use on the Solid Rocket Booster. An ablator or ablative is a material that erodes to dissipate heat. The External Tank attachment bolts and inserts are also being resized to accommodate the increased loads from the separation bolt into the Bolt Catcher Assembly.

A series of static, dynamic and environmental tests are being conducted to determine the design loads and demonstrate the bolt catcher complies with the 1.4 factor of safety requirement.